

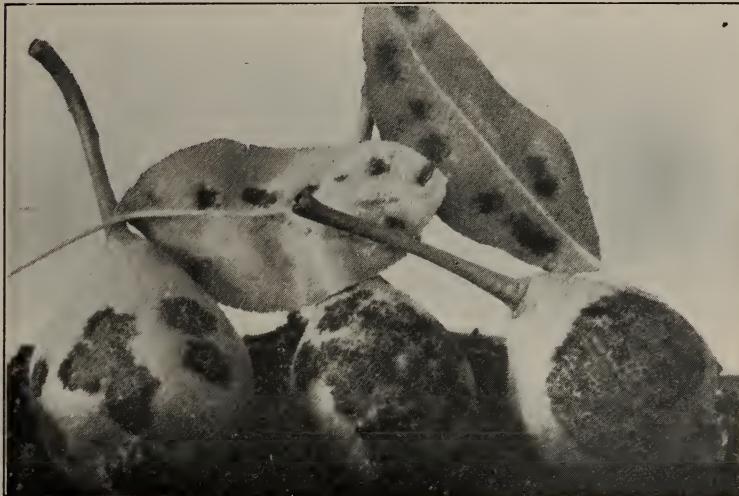
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PEAR SCAB.

BY RALPH E. SMITH.



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PEAR SCAB.

BY RALPH E. SMITH.

Aside from the effects of blight, the pear in California may be considered our most healthy fruit tree. Both in respect to insect and fungous parasites, as well as with regard to the effect of natural conditions unfavorable to the growth of most fruits, the pear is subject to very few serious maladies. Its marked immunity, for instance, against root knot, root rot or "oak fungus disease," and sour sap, three of our most common orchard diseases, is well known, while its ability to thrive in moist, low spots which are fatal to the stone fruits, is frequently taken advantage of in utilizing such places in peach or other orchards which are not suited to the main planting. Similarly with insect pests, it is subject to very few of a serious nature.

Our most common and only serious pear troubles, with the exception mentioned already, are two: the codling worm and pear scab. Both of these—one an insect, the other a fungus—affect the *quality* of the fruit rather than its quantity or the vitality of the tree, and, while entirely distinct in their cause and nature, are so closely associated in their occurrence and economic relations that the practical grower usually considers them together in regard to methods of prevention and their effect upon the crop.

The present bulletin aims to give the practical results of some observations upon the occurrence and treatment of pear scab in California, based upon the general practice in numerous orchards which the writer has been able to keep under observation in connection with other work, together with some special work along this line which has been carried on by growers in various parts of the State in coöperation with this Experiment Station. The conclusions published are not to be regarded as the results of extensive technical investigation, but rather as a demonstration of methods of controlling this disease according to the best knowledge of the subject, with such suggestions for improved methods as may be obtained from the results of the season's work.

Economic Importance of Pear Scab.—Pear scab is one of the most common of plant diseases, occurring in practically all countries where the fruit is grown. Its effects, as already stated, are not upon the life of the tree, nor are they severe upon the fruit in respect to quantity; it is the commercial quality or appearance of the fruit which chiefly suffers. The effect of the disease is well shown in the various figures

illustrating this bulletin. A scabby, corky growth in certain spots on the surface, accompanied by a distortion or deformation of the mature fruit, is the main feature of the disease. Scabby pears are perfectly sound and of normal texture and flavor except in the affected parts. The scab growth is very superficial, affecting only the outer surface tissues, which are hard and corky. Such fruit is perfectly healthful and in no way injurious because of the disease, yet on account of their poor appearance, color, and shape, pears which are badly scabbed are almost entirely useless for any purpose, while if at all seriously affected they are worthless for shipping, undesirable for canning, and poor for drying.

In years of abundant pear scab in California unsprayed orchards have shown losses of from one fourth to nearly all the crop in marketable pears. This loss may be about equally divided between the scab and the worm, although either would be able alone to cause it. In an average year California ships, cans, and dries some 60,000 tons of marketable pears, of a value, at \$25 per ton, of \$1,500,000. From these figures some idea may be formed of the losses from pear scab in the State, considering, in relation to the total tonnage utilized as above, the further amount or proportion rendered entirely unmarketable, and the loss in quality on a large portion of that actually sold—a loss representing the difference between \$40 and \$15 or \$20 per ton in many seasons.

The Disease.—We have already described, and the various figures illustrate, the general effect and appearance of this disease. It affects all varieties of pears more or less, but with considerable difference in respect to the different kinds. The Bartlett is neither the most nor the least affected, but stands intermediate in the list. Most susceptible to scab are some of the later varieties like Winter Nelis and Easter Beurré, and also the little early pear shown on the cover of this bulletin. The apple is also affected by scab, although not nearly as much so in California as the pear, though in the Eastern States both scab and codling worm are worse on apple than on Bartlett pear.

Whether the pear and apple scab fungus are identical has ever been an unsettled question and still remains so. The two are very similar in appearance and structure. Both pear and apple scab have increased decidedly in California within the last few years. In the Sacramento Valley, particularly toward the upper end and east side, pear scab is reported to have been troublesome only since the beginning of the present decade, while apple scab is not yet abundant in the State, but is increasing in the Santa Cruz and southern California mountains. The prevalence of pear scab shows a marked relation to the climatic conditions of various parts of the State and of different seasons. The disease is greatly favored by atmospheric moisture in the spring. Sections with the prevailing dry winds show less pear scab, and in seasons with little spring moisture the disease is less abundant than when the contrary is true.

The first appearance of the scab may be seen upon the young pears or leaves when the fruit is quite small. It appears as brownish velvety spots or patches upon the surface. (See illustration on cover.) In some seasons many pears drop from the tree when as large as small cherries, and on examination may be found to be covered with scab fungus, though the dropping is more often ascribed to other causes by those unfamiliar with the disease. Scab upon the leaves is especially marked in the Winter Nelis. The spots appear upon the under side, often in abundance, and are readily seen and recognized by the dark color and evident fungous growth of a velvety, mold-like nature. Upon the young pears similar spots appear, as in the cover illustration and Fig. 1.

This brownish growth consists of the pear-scab fungus (*Fusicladium pirinum*, Lib.). Its microscopic structure is shown in Fig. 2, represent-



FIG. 1. Young Bartlett Pears with scab.

ing a section through a scab spot on the surface of the fruit. The dark-colored fungous growth occurs, as shown here, mostly in the outer cuticle or extreme surface layer, penetrating very slightly into the interior. The velvety growth on the surface consists of numerous erect threads, which grow up from the surface stratum. At the ends of these threads the oval-shaped spores are produced, which drop off very readily and serve to distribute the fungus. These spores are capable of sprouting when moisture reaches them, and starting the fungus anew. Pear scab fungus also develops upon the bark of the young shoots and twigs of the tree, as well as upon the fruit and leaves, though here it is inconspicuous and not as readily observed as in the latter situations. This fact is of particular importance in California in combating the disease.

As the season progresses and moisture becomes less abundant the visible fungous growth upon the scabby spots become less prominent,

and in the Bartlett disappears almost entirely. Considering this variety alone we find that as the fruit swells the growth of those pears having scab on one side is checked in such places, so that as the other side enlarges the pear twists and doubles over, as in Figs. 3 and 4; or even much worse than this. Comparing the mature Bartlett pears in Figs. 3 and 4, with the young ones in Fig. 1, the nature of this effect is readily seen. In the same comparison we see the brown fungous growth on the young pears, while upon the older ones it has almost entirely disappeared, leaving only the scabby, corky appearance of the surface. This is characteristic in California with the Bartlett, showing that the scab on the mature fruit starts in the spring, and that later infection during

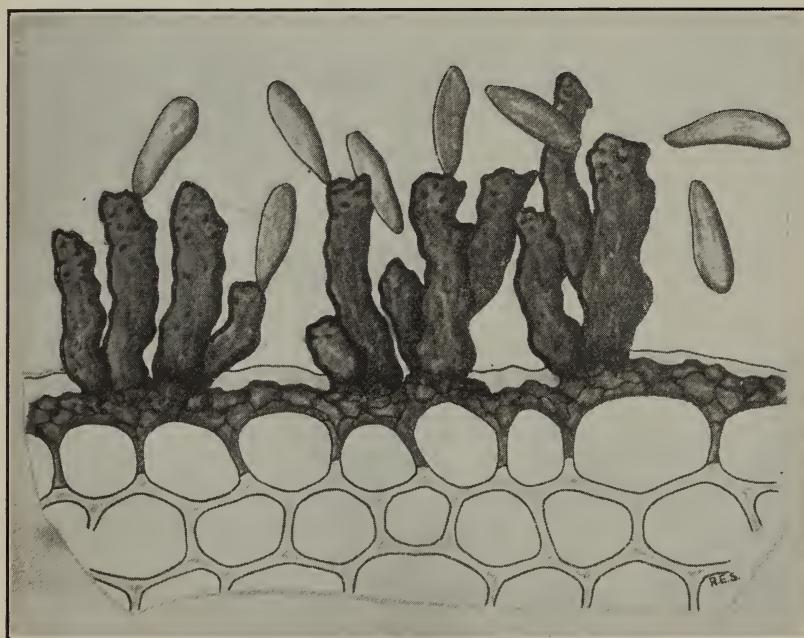


FIG. 2. Section of Scab Spot on fruit, showing fungous growth; much enlarged.

the summer when the pears are nearly grown does not occur, the surface being smooth and free from scab except in the old original spots. On the Winter Nelis, Clairegeau, and Easter Beurré, new scab spots develop later in the summer when the pears are quite large, and brown spots of fungus can be seen on the surface of these pears, without much distortion, when the original spots have reached the condition shown in Figs. 3 and 4. This difference in the time of infection is of practical importance in controlling the disease.

In Bartlett pear orchards severely affected by scab the fruit has been seen to average as bad as Figs. 3 and 4 for the whole crop, while many of the pears were much more distorted, not to mention the worms. Such

fruit is practically worthless and only a source of dissatisfaction to all who handle it. When first-quality Bartletts are in demand at \$40 per ton for the very best, such stuff as this is wanted by no one at any price.

Returning to the consideration of the scab fungus, we find at the end of the season that it is present in the orchard in three places: upon the leaves, upon any scabby fruit that remains, and on the young twigs. The condition of the fungus is about that represented in Fig. 3. The visible surface growth has died away; but in the corky scab-tissue,

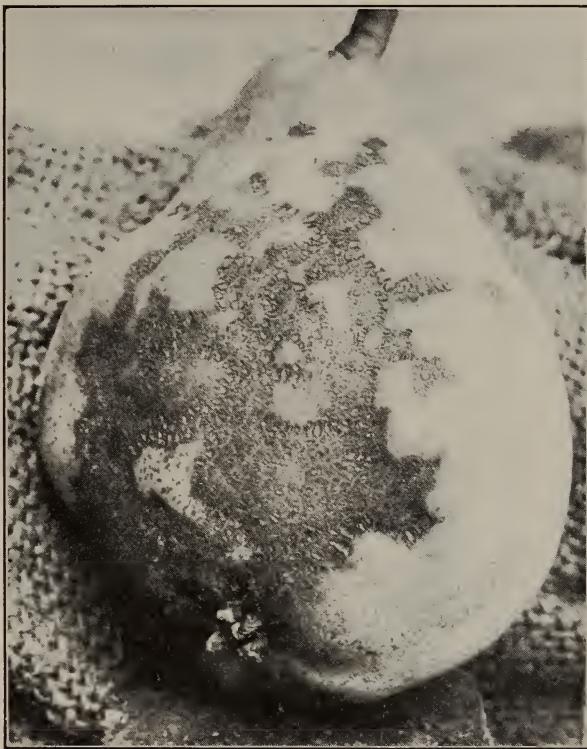


FIG. 3. Scab on Bartlett Pear.

or the surface layers of the leaf or bark, the fungous growth is still present and capable of further growth, although in a dormant condition. The case is quite analogous to that of many California weeds, which flourish in the moist springtime, then die down and disappear from sight in summer, but still exist by roots and seeds in the soil and spring up into life again when the season of required moisture and temperature comes around.

In winter the scab fungus exists and lives through the season upon the dead leaves on the ground and in its growth upon the bark of the twigs, and it is from these sources that it starts again next spring. The spores

of the fungus have no apparent relation to its hibernation, since they sprout with the first moisture and are very sparingly produced after the early summer. It is rather the dormant growth in the leaf and twig-bark tissues which lives over, starting into growth and producing new crops of spores next spring.

The question as to the relative importance of the old leaves on the ground and the bark of the tree itself as a source of scab in spring is of the greatest practical importance. There is no question that the fungus does exist in both situations, so that a study of this in itself gives

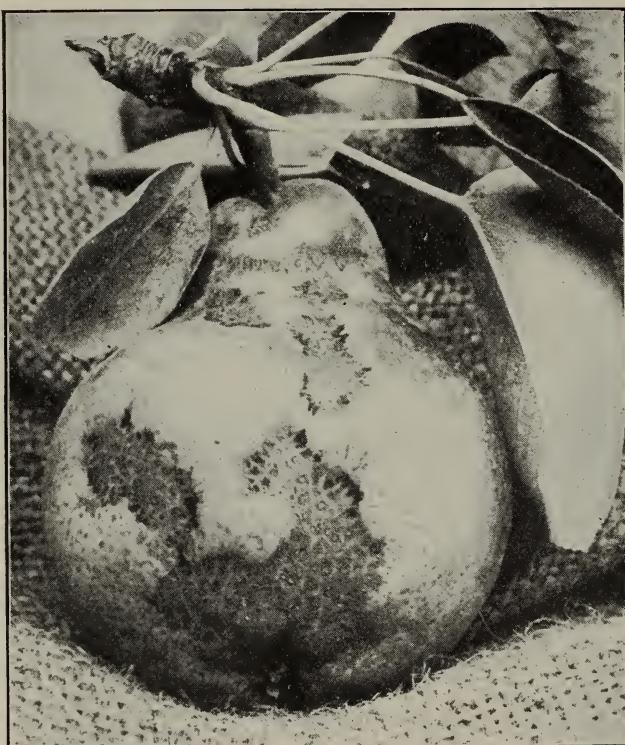


FIG. 4. Scab on Bartlett Pear.

little light on the essential question. The practical results of experiments in treating the disease, however, as brought out in a later chapter, seem to indicate quite plainly that infection takes place in the spring from the bark scab on last year's growth, rather than from the old leaves. This will be more fully considered elsewhere.

CONTROL OF PEAR SCAB.

That pear scab may be effectually controlled by proper and well-timed spraying has been repeatedly demonstrated in many parts of the country. That it is not controlled in a great many California pear

orchards, in many cases even where more or less spraying is done for this particular purpose, is but too well known to all who handle the crop. The object of this work was therefore primarily to find the reason for the failure of much well-meant work which is done, and to point out the best and most economical practice for use under California conditions. In other words, more definite information was needed as to what is effective and essential in the control of this pest, and what is non-effective and useless in regard to present practice.

The usual recommendations for pear-scab treatment, published in bulletins and spray calendars of the various State experiment stations, call for spraying with Bordeaux mixture just as the buds expand, again after the blossoms have fallen, and a third time about two weeks later. This refers to spraying for scab alone, without reference to insect pests. In California the spraying of pears for scab has been largely along the line of general treatment for the eradication of all pests, definite or indefinite. To "clean up the tree" is a popular expression of the object of most pear-tree spraying, except the use of paris green for worms. More definitely stated, the usual California practice of pear spraying consists in treatment with lime, sulfur and salt in January for scale, scab, moss, softening the bark, and a general "clean up." This is applied by some every year, by others once in two or more years, and in still other cases not at all. Beyond this two or three sprayings with paris green and lime are made in summer after the fruit sets, adding bluestone for scab and general results.

The results of this treatment have not been entirely satisfactory in relation to scab control. While the disease has varied in abundance from year to year, orchards sprayed in this way have shown much scab in years when it was abundant and considerable losses have resulted. Neither the early-winter lime, sulfur and salt treatment, or the summer paris green, bluestone, and lime spray, or the combination of the two, has shown decidedly satisfactory results in scabby seasons when closely followed up, although such treatment has been better than none at all.

In spraying orchards year after year for some time it naturally results that, on account of varying weather conditions and other causes, the work is not done at the same time every year. This has been the case in the winter spraying of pear trees with lime, sulfur and salt. The time of such treatment has thus varied from December to the time of blossoming in March, in different orchards and in different years in the same orchard. Various other sprayings have also been done in a variety of instances, differing more or less from the usual practice outlined above. From such sources there seemed to have been demonstrated, in a number of instances in this State, that spraying at some period just before the time of blossoming was particularly effective in the control of scab. One grower, for instance, in spraying with lime,

sulfur and salt, was delayed by rainy weather so much that in one block the buds were much advanced and the spraying not done. Finally a last tankful was put on when the trees were almost in full bloom and the remainder of the block left unsprayed. Although many blossoms were killed by such late treatment with this caustic spray, the effect on scab was most decided, the trees receiving the late treatment producing very much cleaner fruit than those sprayed earlier in the winter or those not sprayed at all. This incident is typical of many similar ones which might be cited. Such experience goes further than to support the usual recommendation of spraying as the buds unfold, representing one of three or more applications, since it appears to indicate the existence of a time when *one* spraying is peculiarly effective under California conditions, or when more than one, close together, might be more effective than the same number at any other time.

With this idea in mind the coöperative work carried on during the past season was instituted. The plan was to find out, by spraying at various definite times, the most effective period of spraying for scab control, and in general the comparative effect of treatment at various times before and after the setting of the fruit. Particular arrangements were made for such work with Mr. Fred Cottle of the O'Toole ranch, San José, and Mr. D. Z. Hawkins of the Aloha Fruit Farm, Anderson, and to the active efforts of these gentlemen in carrying out the work as planned, in spite of extremely unfavorable weather conditions, is due in a large measure the value of the results contained in this bulletin. Some coöperative work was also done with Mr. Edward Rider, of Sacramento, and Mr. Frank Tupper, of Newcastle, while the active promotion of scab treatment in many orchards carried out through the enterprising spirit of the California Fruit Canners' Association, by their representative, Mr. Geo. W. Pratt, was another source of much valuable information. Observations were also made in numerous orchards of the results of various treatments carried out according to the ideas of their owners.

EXPERIMENTAL WORK.

Work at the O'Toole Ranch.—Mr. Cottle's orchard, which received treatment, consisted of Bartletts, Winter Nelis, Clairegaus, Easter Beurrés, and Vicars, giving a long range of blossoming, various degrees of susceptibility to scab, and conditions generally very favorable to a study of this sort. The time of spraying, in this and all the work done, was gauged by the opening of the buds. Figs. 5, 6, 7, 8, and 9 represent typical stages in the opening of pear buds: the first swelling of the whole bud, the expansion of the leaves and separate flower buds, and final opening of the single blossoms. Each fruit bud, as seen from the illustrations, develops several leaves and a cluster of blossoms, though the figures do not all represent the same variety of pear. In the Winter

Nelis and the earlier blooming varieties most of the blossoms open at about the same time (as in Fig. 8), so that the whole orchard comes suddenly into full bloom. The Bartlett straggles along in blooming, like Fig. 9, some blossoms opening a month ahead of others. The dates of full bloom for the varieties present on the O'Toole ranch were about as follows in 1904: Clairgeau, March 29; Easter Beurré, April 1; Vicar, April 6; Winter Nelis, April 8; Bartlett, April 15.

The following table gives a general resumé of Mr. Cottle's spraying, using Bordeaux mixture with 5 pounds of bluestone, 6 pounds of lime,



FIG. 5. First stage in bud development. Slightly swollen.

FIG. 6. Second stage in bud development.

and 50 gallons of water, with no previous spray of any sort during the winter:

Date.	Variety.	No. of Rows, etc.	Buds, as in
March 15	Clairgeau	All	Fig. 7
March 16	Easter Beurré	4 rows	" 6-7
March 25	Easter Beurré	4 rows, second time	" 9
March 25	Easter Beurré	2 rows, first time	" 9
March 25	Winter Nelis	4 rows, first time	" 8
March 26	Clairgeau	All, second time	" 9
March 27	Winter Nelis	7 rows, first time	" 8
March 27	Vicars	All	" 8-9
April 16	Bartlett	All	" 9
May 1	All varieties	All, but checks sprayed with Bordeaux and Paris Green	Passed bloom.

Later spraying with Bordeaux and Paris Green.

This table summarizes as well as possible all the spraying done at this place. Check trees were left of most varieties, so that the amount of scab normally developed could be seen and the gain by spraying thereby estimated. Considering the various varieties the record may be better understood by saying that the Clairgeaus were sprayed twice before the blossoms opened: once when in the stage of Fig. 7, and again ten days later when as in Fig. 9 or partially in bloom. After the fruit was well set they were sprayed again, and still further later in the summer, adding paris green after the blossoms had fallen. Of the six rows of Easter Beurrés, four rows were treated the same as the Clairgeaus,



FIG. 7. Third stage in bud development.

with two sprays before the blossoms opened, while two rows did not receive the first spraying at the third stage (Fig. 7). All received the combined later sprays (except, as should be understood in every case, the unsprayed check trees). Of the Winter Nelis a part were sprayed once at the fourth stage (Fig. 8), and all after the fruit set. The Vicars were all sprayed once when nearly in bloom and several times later like the others. The Bartletts were all sprayed when at the fifth stage (Fig. 9), and later as with all the rest. In several cases individual trees were sprayed when in full bloom, but it could not be seen that this had any injurious effect upon the setting of the crop.

The results of this work were quite instructive. While a decided

gain was apparent from all the spraying done before the blossoms opened, there was still considerable scab on several of the varieties and the fruit was not as clean as could be desired. The Bartletts and Winter Nelis, for instance, sprayed once just before the blossoms opened, and several times later, gave a crop of very good quality, yet not as free from scab as could be desired.

The Easter Beurrés seemed to demonstrate very plainly the secret of the most successful scab control. The four rows of this variety sprayed



FIG. 8. Fourth stage in bud development.

twice before the blossoms opened, as in Figs. 6 and 9, bore fruit very free from scab, while on the check trees almost every pear was scabby. The rows sprayed once in the fifth stage (Fig. 9) were better than the unsprayed, but much more scabby than those which had the earlier treatment. Moreover, a few trees which had the *first* spray but not the second, were much cleaner than those which had the second alone, and nearly as good as the four rows which had both. The difference in this scab-susceptible variety was very marked in favor of the earlier spray,

while with the two sprayings before the blossoms opened, the results were the best of any obtained in the whole work.

The Clairgeaus, all of which received these two treatments, were also very clean and free from scab. In some cases, as with part of the Winter Nelis and various single trees of other varieties, no spray was put on until after the blossoms fell and the fruit had set. In these little gain could be seen over trees unsprayed the whole season. Spraying after the fruit set, with no previous treatment, had almost no effect on the amount of scab.

The fact already mentioned in connection with the development of scab on the different varieties was quite marked in this orchard, namely, that on the Bartletts the injury to the fruit was caused by scab which started with the fruit from the first, and no new spots developed in sum-



FIG. 9. Fifth stage in bud development. Blossoms beginning to open.

mer, while with some of the later varieties new scab spots developed on the fruit after it had attained considerable size. This fact in connection with the Bartlett, and the decided effect with other varieties of checking the development of the fungus so thoroughly by a single early spraying, both indicate an important fact in regard to the *origin of scab in the spring*. If spores from the dead leaves on the ground were the principal source of infection neither of these facts would be expected to hold true, as the fungus would of necessity gradually work up into the tree tops. The fact that it has a definite brief time of development, occurring simultaneously with the development of the pear buds, and that spraying at this time checks the fungus for the whole season, suggest very strongly a development of scab upon the twigs and fruit spurs when growth starts in the spring rather than infection by spores from the ground. (The

same holds true for *peach curl*, *sycamore blight* and all such tree diseases, which make a sudden start in spring, simultaneous on all the trees and all parts of each tree, and where the fungus is known to infect the twigs.)

Work at Anderson.—At the Aloha Fruit Farm, of which Mr. Hawkins is manager, there are about twenty acres of pear trees, all Bartletts. Work was started here along the same general line as at San José, to determine the most effective time for spraying in the control of scab. The disease has increased greatly in this section, coming into prominence only within a very few years. Bordeaux mixture of the same formula as in the other work was used here, adding paris green for worms after the fruit set. Little account of these later sprayings is taken in this bulletin in any instance, as the problem of worm control does not come within the scope of this work.

Mr. Hawkins sprayed his whole orchard, with the exception of two rows, just before the blossoms opened, or at about the fourth stage (Fig. 8). After the fruit had set he sprayed again, including this time one of the two rows omitted before. Thus the bulk of the orchard was sprayed twice: once before and once after the fruit had set; one row was sprayed once, at the latter time, and the last row was not sprayed at all. Examined on June 13, the following notes were made by the writer: "Scab abundant on last row. Nearly as bad on row sprayed once; very little difference, if any. Scarcely any on remainder." Here again was evident the decided effect of spraying shortly before the blossoms opened and the lack of effect of later spraying upon scab development.

Had the comparative amount of scabby fruit been calculated and the difference in value estimated, the one early spraying in this orchard would show an amount of saving beside which the cost of the operation would be insignificant. Yet had the first spraying been postponed for two weeks or less, and the same amount of work done, and done just as thoroughly, later in the season, no result whatever would have been evident, as shown by the abundance of scab on the late-sprayed row. In fact, so far as the effect on scab is concerned the experiment shows that the second spraying of the whole orchard had very little effect, and could have been omitted altogether or done more profitably at about the second stage (Fig. 6), making the two sprays at the second and fifth stages of bud development (Figs. 6 and 9). If spraying for worms is done just after the fruit sets there is, of course, but very little extra expense in adding bluestone and lime to make a Bordeaux mixture, and this will do no harm and perhaps a little good. No winter spraying was done in the Hawkins orchard previous to the Bordeaux spray.

Work at Sacramento.—Mr. E. Rider at Sacramento had a Bartlett pear orchard of which the trees, on one side particularly, had been

affected by scab. Spraying of this orchard was greatly interfered with on account of the wet condition of the soil, but part of it was sprayed in winter with lime, sulfur and salt. As the buds were swelling and before the blossoms opened, the rows on the side worst affected by scab in previous years were sprayed twice with Bordeaux mixture, and once after the fruit set. The result a few weeks later was very marked in this orchard. The usual condition was reversed: the sprayed rows on the previously scabbiest side having very clean fruit, while the unsprayed and usually cleanest rows were much the worst. This again was a very striking proof of the effectiveness of proper spraying for this disease.

Work at Newcastle.—Mr. Frank Tupper of Newcastle sprayed some pear trees according to arrangements made for testing the matter in that section. A block of Bartletts in his orchard, without previous treatment, were sprayed with Bordeaux mixture just as the blossoms were opening, the bulk of the orchard receiving lime, sulfur and salt in March, before the buds had started or swollen much, and all being sprayed with Bordeaux-paris green after the fruit had set. None of this spraying succeeded in controlling the scab fungus very effectually. The fruit in the trees sprayed specially with Bordeaux was scarcely better than that on unsprayed trees. Apparently the lime, sulfur and salt treatment was too early and the Bordeaux too late for the best results in scab control. Mr. Tupper carried on the work faithfully according to directions, and this negative result is no less valuable in demonstrating the most effective time for scab control than those in which more saving was accomplished.

Work in other Orchards.—In various orchards the writer has followed the effect on scab of spraying with lime, sulfur and salt, *before the fruit buds swell*. In one case, for instance, part of the orchard was left unsprayed, the work stopping part way down a row of Winter Nelis. This was in February. In the amount of scab next summer no difference could be seen in this row or in the sprayed and unsprayed parts of the whole orchard. All were equally scabby. Many similar instances of this could be cited, all showing that while winter spraying with lime, sulfur and salt kills scale when present, cleans up the trees and improves their appearance and condition generally, its actual effect upon scab the next season is very slight. It is apparently too early to catch the fungus in an active condition, and this fails to prevent its later development. This spray would no doubt be equally effective with the Bordeaux mixture could it be used safely as late in the season. It has, however, no advantage over the latter as a fungicide, so that each is best in its own place in the spray calendar.

Spraying for scab *after the fruit sets* may be dismissed with equal brevity. With some of the later varieties this may have some effect in

checking the summer development of scab, and in any case the expense of adding bluestone to the codling worm spray is so small that for the general purpose of keeping down the scab fungus in the orchard as much as possible all the year round it is advisable to make a Bordeaux mixture of the arsenical spray. This late treatment, in itself, however, has in every instance been shown to be of absolutely no effect in keeping down scab in Bartletts, in the crop of the season, and were it not for the worm-spray combination could probably be omitted with profit.

The failure of the ordinary practice of spraying with lime, sulfur and salt in winter, and arsenical Bordeaux in summer for scab control, is thus seen to come about because the former is too early and the latter too late. The present work indicates that a crop of scab develops from dormant fungous growth on the fruit spurs and twigs just as the buds open, that this infects the fruit when very young, and that the most effective spraying destroys this growth before the blossoms develop or infection takes place, rather than protecting the young fruit when formed.

DIRECTIONS FOR SPRAYING PEARS TO CONTROL SCAB.

(To be combined in the various localities with the best known practice for codling worm control.)

1. Plow under or clean up the dead leaves in the fall as much as possible.
2. For very thorough results, spray with lime, sulfur and salt every other year as late in winter as possible.
3. Spray with Bordeaux mixture twice while the buds are unfolding beginning the first time (with formula A) when the buds are in the second stage of development as in Fig. 6, the second (with formula B) when as in Fig. 7, or about a week or ten days apart. Remember that the idea is to kill the scab developing on the bark as the buds swell, and not on the young pears after they have formed. For a single treatment the early Bordeaux spray is most effective.
4. Begin the spraying in large orchards as early as the second stage of bud development, as in Fig. 6, so that if delays occur the trees will get at least one spraying before it is too late. Before the first (Fig. 5) or after the fourth stage (Fig. 8), very little direct good can be done on the present year's scab by any treatment, especially with Bartletts.
5. Add bluestone to the paris green-lime spray used against worms for general results, especially with the later varieties of pears.

FORMULAS.

Bordeaux Mixture.—

(A)	Bluestone	8 lbs.	(B)	Bluestone.....	5 lbs.
	Quicklime	10 lbs.		Quicklime	7 lbs.
	Water	50 gals.		Water	50 gals.

Dissolve the bluestone and slake the lime in separate barrels. Strain the bluestone into the spray tank; make up to about 40 gallons, then strain in the lime mixed with the remaining 10 gallons of water. If the two materials are mixed outside of the spray tank, each should first be well diluted. Stock solutions of bluestone, 1 pound to 1 gallon, can be kept indefinitely.

Lime, Sulfur and Salt.—

Lime	40 lbs.
Sulfur	20 lbs.
Salt	15 lbs.
Water	60 gals.

Slake the lime, add the other ingredients, boil from one to two hours, strain, and apply while hot. This is the usual formula, although some use considerably less of the ingredients.

A method of cooking, as follows, is also finding considerable use: Make the sulfur into a paste with hot water, place the lumps of lime in a tight cask, pour on the sulfur, and add 10 or 15 gallons of boiling water. The cask is then covered tightly with sacks and a wooden cover, and an extremely violent boiling takes place. When this begins to subside the mixture is stirred thoroughly and after all boiling stops it is strained into the spray tank, the salt having been added, with enough more boiling water to make up the required quantity. For general purposes this self-boiled mixture appears to be satisfactory and is much easier prepared than by the old method. Its comparative value as an insecticide must be left to the entomologists to decide.

Arsenical Bordeaux.—

Paris Green.....	$\frac{1}{2}$ to 1 lb.
Bordeaux Mixture	100 gals.

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